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ABSTRACT

The problem posed by this study was to determine a method of presenting information that would maximize learning, by taking into account the learner's conceptual tempo, one aspect of his cognitive style. Specifically, this study investigated the possible interaction effects of the learner's impulsive-reflective disposition with the rehearsal part and standard methods of presenting material in a multi-trial free recall learning paradigm. The study also reviews the literature regarding the results of differentiated instruction for different characteristics of learners, commonly referred to as aptitude-treatment interaction (ATI). The major hypothesis of the study which expected a significant interaction between methods of presenting the free recall learning task and the conceptual tempo of the learner was not confirmed, due to the lack of sufficient uniqueness in the three treatments to elicit differentiated effects of reflective and impulsive subjects. (Author/LAA)

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THE EFFECT OF INSTRUCTION ON LEARNING

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The problem posed by the present study was to determine a method of presenting information that would maximize learning, by taking into account a dimension of the learner's cognitive style. Specifically, this study investigated the possible interaction effects of the impulsive-reflective disposition of learners with various methods of presenting material in a multi-trial free recall learning paradigm.

It is generally acknowledged that there is no best method of instruction for all children, and that, therefore, methods of instruction should be differentiated in such a way as to maximize their compatibility with the individual characteristics of the learner. To accommodate these individual differences, the goal, then, becomes one of discovering what educational methods will, when matched with particular student characteristics, maximize learning.

In spite of the many pleas that individual differences be given greater regard in the context of human learning, (Cronbach, 1967; Cronbach & Snow, 1969; Glaser, 1972; Jensen, 1967; Messick, 1969; Levin, Rohwer & Cleary, 1971,) few research efforts have been directed toward this end. Ausubel (1968) has indicated that empirical testing and confirmation of the proposition that effective teaching must accommodate individual differences has "been almost totally neglected by educators and educational psychologists. In view of the tremendous emphasis that members of these professions have placed on individualized instruction, at least in the realm of theory, one might have anticipated more concern with providing greater empirical support for its efficacy." (P. 261)

In view of the above, the present study was designed to determine a

method of presenting information that would maximize learning, by taking into account the individual differences of learners.

The literature regarding the results of differentiated instruction for different characteristics of learners, commonly referred to as aptitude-treatment interactions (ATI), has recently been reviewed by Bracht (1970) and Cronbach and Snow (1969). The goal of research on ATI is to find significant disordinal interactions[1] between alternate treatments and personological variables, i.e., to match specific instructional methods to selected learner characteristics so as to optimize the performance outcome. In both of these comprehensive reviews, few aptitude-treatment interaction effects were found to support the notion that treating a subject in one way will cause him to achieve at a higher level than if he were treated differently. While a great deal of support exists for an ATI viewpoint in educational circles, the experimental proof of this notion remains to be more fully demonstrated (Reynolds & Balow, 1972).

To date, one of the major deficiencies of ATI research has been the lack of any comprehensive models for maximizing student performance as an interactive function of method of instruction and aptitude patterns of the learner. Until the recent work of Snow (1970) and Solomon (1971) appeared in the

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[1]A distinction is made between two types of interaction: ordinal and disordinal. An ordinal interaction is one where the rank order of the treatments is constant, whereas a disordinal interaction is one where the rank order of the treatments change. In the disordinal interaction, the regression lines for treatment intersect somewhere within the range of the aptitude variable under investigation, while in the ordinal interaction the regression lines have different slopes but do not intersect within the aptitude range.

literature, there were essentially no models available for generating ATI hypotheses based on defendable rationales.

According to the models they have proposed, an instructional treatment can be designed to compensate for the deficiencies that the learner exhibits, or it can try to capitalize on what the learner is already capable of doing (Snow, 1970; Solomon, 1971). With the Compensatory Model, the instructional methods are designed to compensate for the apparent weaknesses and deficiencies of the learner. In this model, the instructional treatment can be viewed as a prosthetic device that provides the information processing function that the learner cannot provide for himself. It can also be conceived as a counteracting device designed to neutralize a debilitating learning characteristic. The Preferential Model, on the other hand, is the antithesis of the Compensatory Model, wherein the instructional methods are designed to capitalize on the apparent strengths and preferences of the learner. Both the Preferential and Compensatory Models are concerned with the relationship between the learner's characteristics and the method of instruction rather than the content of instruction (Solomon, 1971).

With respect to the myriad learner variables investigated in the ATI literature, one category of individual differences that seems to hold a great deal of promise, while concomitantly receiving little research attention, is that of cognitive style (Bracht, 1970; Cronbach & Snow, 1969; Jackson, 1970; Tallmadge & Shearer, 1971). As defined by Jackson,

> the concept of cognitive style describes an individual's preferred mode of organizing his world, and includes

> dimensions primarily concerned with perceiving, thinking, remembering, problem solving and interpreting and processing information. These processes are considered to be stylistic because attention is directed at the person's problem-solving strategy or his typical mode of performing rather than his level of skill... (P. 9)

Conceptual tempo was the cognitive style dimension that represented the aptitude variable in the ATI model of this study. Conceptual tempo was selected as the aptitude of interest because this learner disposition is directly related to problem solving behavior. Kagan and Kogan (1970) contend that the degree to which a learner "pauses to evaluate the quality of his cognitive product acts on the entire spectrum of cognitive processes by influencing the quality of initial decoding, recall, and hypothesis generation." (P. 1309)

Aptitude - Treatment Interactions: Aptitude

Snow and Soloman (1968) have defined aptitude as "any individual difference variable which functions selectively with respect to learning, that is, which appears to facilitate learning in some students and some instructional treatments while limiting or interfering with learning in other students and other instructional treatments." (P. 8)

Definition of Conceptual Tempo

Kagan and his colleagues (Kagan, Rosman, Day, Albert & Phillips, 1964) have identified children with two different conceptual tempos, namely, reflective or impulsive. When presented with a problem of high response uncertain-

ty, the impulsive child has a tendency to offer responses at the first opportunity with only a minimum consideration given to their appropriateness or validity. On the other hand, the reflective child has a propensity for withholding responses long enough to reflect upon their validity in contrast to quick and unconsidered responses.

With respect to impulsive and reflective behavior, Kagan (1965a) has cautioned that by itself neither tempo should be considered superior to the other. He indicated that the nature of the task will generally determine whether performance is facilitated by either a reflective or impulsive approach.

Conceptual tempo is defined by the degree of accuracy and length of response time required in making a selection among several possible alternatives in a problem-solving task. A reflective tempo is characterized by few errors and a long decision time, while an impulsive tempo is associated with a fast decision time and many errors.

The Matching Familiar Figures Test (MFF) has been the instrument used to classify individuals as impulsive or reflective using the criteria of response latency and error rate. In this task, the subject is presented with a standard and six variants. He is required to select the one variant that is identical to the standard. A record is made of the latency to the first response and the total number of errors for each item.

Aptitude - Treatment Interactions: Treatment

The second major class of variables in the ATI model of this study consisted of the different methods of presenting a free recall learning task.

A free recall learning paradigm was employed because a great deal is known about the mental processes believed to be involved in this task. In addition, it was selected in order to insure that the effects of the differential methods could be assessed under highly controlled task conditions.

For the current study, three distinctly different methods (Part, Rehearsal, Standard) of presenting the free recall learning task were used with subjects who varied in conceptual tempo. Although all three methods were presenting equivalent information, they were structured in such a manner as to match the conceptual tempo characteristics of the learners. Using the Compensatory Model as a guide, both the Part Method and the Rehearsal Method were designed with the express intention of compensating for the apparent information processing deficiencies of impulsive subjects as well as counteracting their impulsive behavior. The Standard Method of presentation, on the other hand, which was based on the Preferential Model, was designed to interact with the strengths of reflective subjects.

The major supposition in the development of these three methods of presenting the free recall learning task was that the performance of reflective subjects mirrors mature, or cognitively more advanced solution strategies than does the less developed or more immature solution strategies of impulsive subjects.

Rehearsal Method

Generally speaking, impulsive subjects exhibit performance deficiencies on memory tasks and do not seem to assimilate new information with the same

fidelity and extensiveness that is characteristic of reflective children (Kagan and Kogan; 1970). For example, in a verbal learning study conducted by Kagan (1966), reflective subjects recalled significantly more words and produced less intrusion errors than impulsive subjects. Kagan suggested that the inferior performance of the impulsive subjects is attributable to their inability to deliberate and consider all of the available information.

One way to counteract a lack of deliberation and attentiveness to materials is to expose subjects to a treatment condition which forces them to attend to all the materials. The Rehearsal Method of presenting the free recall task was designed to specifically enforce the impulsive subjects' attention on the information being presented. In this method the subject had to overtly repeat twice the name of each stimulus as it was presented.

Instructions to overtly verbalize items have facilitated young children's performance in studies of visual discrimination learning and short-term memory (Goulet, 1969; Hagen & Kingsley, 1968; Millgram & Furth, 1963; Spiker, 1963) by evidently increasing their attentiveness and the response strength of individual items. The Rehearsal Method can be viewed as an enforced attention procedure designed to counteract the attentional deficiencies found in impulsive children.

In addition to this attentional deficiency in verbal tasks, impulsive subjects apparently do not use the information that is available as extensively as reflective subjects. Kagan and Kogan (1970) believe that this is so because impulsive subjects tend to be passive receivers of information while reflective subjects actively and efficiently organize the information.

One of the possible reasons that impulsive subjects may fail to actively

organize the input on a verbal learning task is their inability to engage in spontaneous labeling behavior. A number of studies have indicated that very young children do not employ spontaneous labeling and rehearsal behavior in verbal learning tasks (Corsini, Peck & Flavell, 1968; Keeney, Cannezzo & Flavell, 1967; Flavell, Beach & Chensky, 1966).

It was anticipated that the Rehearsal Method would enhance the performance of impulsive subjects by supplying them with a prosthetic device designed to provide them with a set to use verbal labels. In addition, it was also assumed that the Rehearsal Method would make the impulsive subjects more active learners, since one of the major advantages of a rehearsal condition is that it arouses a more active attitude on the part of the learners (Hovland, 1951).

On the other hand, evidence has been provided that strategies which involve rehearsal in memory tasks develop with increasing chronological age. Hagen, Meacham and Mesibov (1970) and Hagen and Kingsley (1968) have found that induced labeling interferes with more efficient strategies in memory tasks and can produce deleterious effects. While imposed verbal labels facilitates the performance of subjects who have not developed strategies for coping with specific task demands, they are distracting to those individuals who use other strategies in the task performance. Since the reflective subject tends to employ more mature solution strategies, it is envisioned that the Rehearsal Method will interfere with his spontaneously generated labels and rehearsal pattern. Inasmuch as the reflective subject implicitly verbalizes, he is confronted in the Rehearsal Method with an additional task that makes him vulnerable to interference effects.

It is therefore hypothesized that the Rehearsal Method facilitates the performance of the impulsive subjects on the free recall task by providing them with cues for memory supports and attentional processes. On the other hand, it is hypothesized that the performance of reflective subjects is impaired under the Rehearsal Method because of the possibility of interference produced by the experimentally induced rehearsal strategy.

Part Method

When presented with a problem-solving situation, Adams (1970) maintains that reflective and impulsive subjects differ because the reflective subjects generate more solution alternatives, while the impulsive subjects lack or do not employ efficient strategies for actively organizing the informational input.

Inasmuch as the impulsive subjects are deficient in employing coding strategies during conventional instructional tasks, the question arises as to whether in the free-recall task a method of presentation could be designed which inherently contains a strategy for organizing material. Jackson (1970) has suggested that impulsive subjects should be provided with some type of external assistance, since they might benefit most by having structure imposed in a context wherein a strategy is outlined by the treatment rather than provided or discovered by the subjects themselves. A treatment such as this would be compensatory in nature, since it contains the information processing functions that the learner cannot provide for himself (Snow, 1970).

When confronted with the task of learning a list of items as in a free recall task, a fundamental strategy used by individuals is to subdivide the

material into smaller groups by some means and then recall these groups, which are stored in memory, in their appropriate order. A recurrent question related to the strategy of subdividing materials to be learned is whether it is more efficient to practice a task as a whole or to divide the material into parts and to combine the parts after each has been learned independently.

Garner and Whitman (1965) and Postman (1969) maintain that generally there is essentially no difference between whole learning and part learning. The part methods have the advantage that they subdivide the material into small and relatively easy units, and the time spent in the acquisition on the individual parts will be less than the time required for the mastery of the intact whole list. The whole method has the advantage that it obviates the time lost in connecting previously learned individual parts. On the other hand, Mc Geoch and Irion (1952) maintain that, with younger subjects, the part method is more effective and that, with increasing chronological age, the whole method becomes relatively better than part methods.

In line with this finding, it was believed that the performance of impulsive or immature learners would be facilitated if they were exposed to a Part Method of presentation, which inherently contains an information processing strategy, i. e., the subdivision of the list into smaller parts. It was anticipated that the Part Method of presentation, by supplying the impulsive subjects with this information processing strategy, would circumvent their deficiency in organizing the informational input.

An additional rationale for the possible efficacy of the Part Method with

impulsive subjects was that it would stave off what Kagan (1965) believes to be their need for quick success. In the Part Method, the subject was provided with reinforcement more quickly in the acquisition of the individual parts than he was when required to master the intact whole list. Since the impulsive subjects only had to cope with a small portion of the list of items initially, rather than the entire intact list, it was anticipated that this Part Method of presentation would satisfy their need for quick success.

The emphasis of the Part Method was on supplying the impulsive learner with a strategy for processing the material and meeting his need for quick success. This method of presentation, however, was believed unsuited for the reflective learner, who could provide the needed strategy for himself. The Part Method, by grouping the items for the subjects, restricts the degree of control the learner had over his own organizing activity. It was believed this would impede or severely retard the reflective subject's performance by preventing him from developing stable groupings of his own making. Bower (1970) has indicated that if the groupings experimentally imposed on the input trial are consistent with the groupings that the subject would naturally employ, his recall should be facilitated. Likewise, if the input groupings conflict with the subject's natural groupings, the input trial should actually reduce his recall.

It is therefore hypothesized that the Part Method facilitates the performance of impulsive subjects on the free recall task by providing them with an information processing function as well as meeting their need for quick success. On the other hand, it is hypothesized that the performance of reflective subjects is impaired under the Part Method because of the possibility of

interference produced by the experimentally produced grouping of items, which would be in conflict with the subjects own grouping of items.

Standard Method

Both the Rehearsal and Part Methods of presentation require the reflective subject to adopt an order of recall different from or incompatible with the one he would normally choose were he free to recall without the constraints inherent in these methods. In the Kagan study (1966), which compared the recall performance of reflective and impulsive subjects, the superior recall of the reflectives was demonstrated using a Standard Method of presentation. Here the entire list of items is presented in a single trial (input phase) which is followed by an output phase on which the subject may recall items in any order.

From the theoretical framework provided by Snow (1970), the Standard Method of presentation is based on the Preferential Model for generating ATI effects. For the Standard Method is designed to capitalize on what the reflective subject is already capable of doing, with particular emphasis on his strengths and preferences.

It is believed that the Standard Method favors the reflective subject because it provides him with a great deal of associational latitude and freedom of constraints in organizing the materials. On the other hand, the impulsive subject is apparently handicapped under this method of presentation, because he is not provided with a systematic way of coping with the materials.

Specifically, the Standard Method does not provide the cues and techniques the impulsive subject needs in order to compensate for his lack of spontaneously

produced and effectively employed labeling responses and attentional processes. For these reasons, it is hypothesized that the Standard Method of presentation of the free recall task, as compared to the Rehearsal and Part Method, enhances the performance of reflective subjects and diminishes the performance of impulsive subjects.

Statement of Problem

The purpose of this study was to investigate one aspect of cognitive style, conceptual tempo, as a classificatory variable for assigning subjects to differential treatments. Based upon the Preferential and Compensatory Models, differential methods of presenting equivalent information in a free recall task were used with subjects who varied in conceptual tempo. It was believed that optimal performance on this verbal learning task would result when the learner was provided with an instructional method uniquely suited to his conceptual tempo.

With any research methodology adapted for the study of ATI, Mitchell (1969) has cautioned that the developmental factor should be very carefully considered. He indicated that "a given interaction may be more timebound to a particular level of development than is commonly recognized. Many interactions may be in fact three-way interactions, with the temporal dimension as the third factor." (P. 703)

Since it was conceivable that an interaction between conceptual tempo and treatments could occur at one level of development and not at another, two different age groups were used as subjects in the study. The two different age

groups consisted of children who were enrolled in the primary and intermediate grades in elementary schools.

Hypotheses

The major question posed in the present study is the following: Can a significant source of variability in the performance of a free recall task be accounted for by the degree of congruence between the methods of presenting the information and the conceptual tempo of the subjects? The following hypothesis is explored:

There is a significant interaction between method of presentation and conceptual tempo. Specifically:

(a) Impulsive subjects recall more words on the Part Method of presentation than on the Standard Method of presentation, whereas reflective subjects recall more words on the Standard Method of presentation than on the Part Method of presentation.

(b) Impulsive subjects recall more words on the Rehearsal Method of presentation than on the Standard Method of presentation, whereas reflective subjects recall more words on the Standard Method of presentation than on the Rehearsal Method of presentation.

In addition to the hypothesis stated above, the following exploratory interaction effect was also examined. The joint effect of conceptual tempo, methods of presentation and grade accounts for a significant portion of the

variance found in the criterion variable. This three-way interaction was examined to determine if a tempo by treatment interaction would emerge at one grade level and disappear at another.

METHOD

This study compared the performance of impulsive and reflective primary and intermediate grade students who were randomly assigned to three different methods of presenting a free recall learning task. The design of the study was a 3 (treatment) x 2 (tempo) x 2 (grade) x 2 (list) factorial analysis of covariance with intelligence and sex treated as covariates.

Subjects

Three hundred children consisting of 150 primary grade (7- and 8-year-olds), and 150 intermediate grade (10- and 11-year-olds) students served as subjects. An equal number of primary and intermediate grade subjects were drawn from the Campus Laboratory School at the State University College at Cortland, New York, and the Norwood Avenue School, District No. 4, Northport, New York. Children from both these schools were essentially from middle-class families.

At each grade level of both schools, lists were prepared of students who had no known visual and auditory deficiencies and who met the specified age parameters. In addition, only those students who had a speaking knowledge of English as well as a standardized IQ score recorded on their cumulative folder were included in the sample.

From the group of students at each school who met the above criteria, a random sample of 75 subjects was drawn at each grade level. The subjects from each school were then combined at their respective grade levels to form a pool of 150 primary and 150 intermediate grade subjects.

Materials

The Matching Familiar Figures Test and a free recall task were employed in this study.

Matching Familiar Figures Test

Two trained examiners administered the MFF test to each of the 150 primary and intermediate grade subjects. The MFF test consists of 12 standards, which are common objects familiar to young children, and six variants of each standard. The object of the task is to have the child point to that variant which is identical to the standard which remains in view. The test items are constructed such that each "incorrect" figure differs from the standard with respect to only one design feature, and each incorrect figure differs from the standard in a unique way. Two practice trials preceded the first item.

For each of the 150 primary and intermediate grade subjects, a record was made by the examiners of the latency to first response by means of a stop watch, and the total number of errors for each item.

Two measures were obtained from each subject: 1) the total latency to first response on all 12 items, that is, the response time and, 2) the total number of errors on all 12 items.

The response time and errors were combined to measure the reflection-impulsivity dimension. A double median split was performed by the experimenter on response time scores and on error scores for the primary and intermediate grade distributions separately. The primary group obtained a median score of 10.0 on errors and 136.5 on response time, while the intermediate group obtained a median score of 7.5 on errors and 154.2 on response time. Those above the group median on response time, but below on errors, were classified as reflectives, and those below the median on response time, but above on errors, were classified as impulsives. All those above the group median on both response time and errors and those below the median on both response time and errors, which accounted for approximately 1/3 of the subjects, were not classified and excluded from further consideration.

This classification procedure provided a sample from which 45 impulsive and 45 reflective subjects were randomly selected at both the primary and intermediate grade levels. Descriptive data for these sample subgroups are presented in Table 1.

TABLE 1

Means and Standard Deviations of Age, IQ Score,

Response Time & Errors for Sample Subgroups [a]

Group	Age (in mos.)		IQ Score		Response Time[b]		Errors[c]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Primary Reflective	97.3	3.6	113.7	10.8	268.4	119.0	6.3	2.3
Primary Impulsive	96.4	3.3	108.0	12.9	102.8	20.9	15.6	3.9
Combined Primary	96.8	3.5	110.9	12.2	185.6	118.9	10.9	5.6
Intermediate Reflective	134.6	4.2	111.2	12.7	334.1	150.9	3.5	2.2
Intermediate Impulsive	133.2	4.6	109.8	13.6	101.0	31.9	13.3	4.7
Combined Intermediate	133.9	4.4	110.4	13.1	217.6	159.6	8.3	6.1

[a] N=180

[b] Latency to first response in seconds summed over 12 items. Primary range 59-674. Intermediate range 28-832.

[c] Total number of errors for all 12 items. Primary range 0-29. Intermediate range 0. 27.

Free Recall Learning Task

In the multi-trial free recall task, the subject is presented a list of items in a single trial (input phase) which is followed by a recall task (output phase) on which the subject may recall items in any order. This latter feature of the task, recall in any order, allows the subject freedom to organize the items as he sees fit.

For the free recall learning task used in this study, two different lists, of 8 pictures of common objects selected from the Peabody Language Development Program Kit, were constructed. The objects were photographed in color by a Leitz Peprovit copying camera outfit and made up as 2" x 2" slides for presentation by means of a Kodak carousel projector. The sixteen objects were representations of high frequency words (AA) from the Thorndike-Lorge (1944) word count. A Lafayette electric timer was attached to the projector to regulate slide exposure time. Slides were presented by rear projection, so as to minimize extraneous distractions, on a 13" x 13" opaque screen mounted in a vertical 2 1/2' x 3 1/2' gray cardboard panel, encased in a wooden frame.

The lists were constructed so that obvious associative, conceptual and perceptual relations between items within a list were minimized. The lists were examined by the experimenter using the oral word association norms for young children developed by Palermo and Jenkins (1966).

The examination revealed that when a word in list A and B below corresponded to a stimulus word used by Palermo and Jenkins, none of the remaining words in the list were given as response terms by the norming population. In addition, when a word in the list was found in the response terms of the norming

population, none of the remaining words in the list were similar to the stimulus word used by Palermo and Jenkins for that particular response term.

The words included in each of the lists are as follows:

List A	List B
1. Cow	1. Shirt
2. Apple	2. Watch
3. Bed	3. Car
4. Shoes	4. Chair
5. Wagon	5. Drum
6. Phone	6. Horse
7. Knife	7. Brush
8. Lamp	8. Hat

Eight separate item randomizations were prepared for each list, one for each trial, with the restrictions that a specific item would not follow the same item more than once, or appear as both the last and first item on two successive trials. The different ordered lists appeared in the first trial position on a rotation basis. For each condition, list A or B was presented to the subject at a rate of one item per 1.5 second. After one completed trial, the subject had 60 seconds to recall the items in any order. There were eight learning and eight recall trials. Recall of the items was oral and tape recorded to insure scoring accuracy.

Procedure

A trained female examiner was assigned to collect the data at each of the

schools. Each subject was brought to a quiet room by the examiner who was instructed to act in a warm and friendly manner. The subject then had the MFF test administered to him.

After the administration of the MFF test to students at both schools, the experimenter identified a sample of 45 reflective and 45 impulsive subjects at each grade level using the double median split previously described. Within each age group, 15 impulsive and 15 reflective subjects were randomly assigned to the three treatment conditions by the experimenter. The order of presentation of the various conditions as well as the assignment of lists A and B to the conditions were counterbalanced as far as possible within groups.

Approximately six weeks following the MFF administration, the individuals selected for inclusion in the study were taken to the examination room by the examiners, who were given no prior knowledge of the subject's conceptual tempo classification.

The subjects were seated in front of the opaque screen and the following instructions were read to them depending upon the condition to which they had randomly been assigned:

Standard Method

> _____(Name)_____, we are going to play a game to see how well you remember. You are going to see eight different pictures on this screen (E points). After you have seen all eight pictures you will see a red slide (E shows slide). When you see the red slide you are to tell me the names of the pictures you have just seen in any order that you can remember. I will show you the eight pictures eight different times and each time I show you the pictures they will be mixed up in a different way. Remember, the object of the game is to tell

me the name of the pictures in any order when you see the red slide. Do you understand?

Rehearsal Method

(Name), we are going to play a game to see how well you remember. You are going to see eight different pictures on this screen (E points). As you see each picture I want you to say out loud the name of the picture twice. After you see all eight pictures, you will see a red slide (E shows slide). When you see the red slide, you are to tell me the name of the pictures you have just seen in any order that you can remember. I will show you the eight pictures eight different times and each time I show you the pictures they will be mixed up in a different way. As you see each picture you are to say its name out loud twice. Remember, the object of the game is to tell me the names of the pictures in any order when you see the red slide. Do you understand?

Part Method

(Name), we are going to play a game to see how well you remember. You are going to see eight different pictures on the screen (E points). At first you will see four of the pictures. After you see the four pictures you will see a red slide (E shows slide). When you see the red slide you are to tell me the name of the pictures you have just seen in any order that you can remember. I will show you the four pictures four times and each time I show you the pictures they will be mixed up a different way. After you are finished with the first four pictures I will show you another four pictures in the same way for four times. Then I will show you the eight pictures together for four times. Remember, the object of the game is to tell me the names of the pictures in any order when you see the red slide. Do you understand?

Variables of Interest

Independent Variables

Treatments. The three methods of presenting the free recall learning task

to which the subjects were randomly assigned: Rehearsal, Part, and Standard.

Tempo. Using the MFF test, a subject was classified as reflective if he scored above the median on response time and below the median on errors, while he was classified as impulsive if he scored below the median on response time and above the median on errors.

Grade. A subject who fell in the age range from 7 to 8 years of age was classified as being on the primary level, while a subject who fell in the age range from 10 to 11 years of age was classified as being from the intermediate level.

List. There were two lists of eight pictures, one labeled List A and the other List B.

Dependent Variable

Number of words recalled. After completion of each input trial on the free recall learning task, the subject had one minute to recall these words in any order. The criterion measure was the number of pictures recalled summed over the eight trials.

Control Variables

Intelligence. Because of recent findings (Eska & Black, 1971) indicating that conceptual tempo is not orthogonal to intelligence, this later variable served as a control variable. It consisted of the latest recorded standardized intelligence test score that appeared on the cumulative record of each subject.

Sex. Since Lewis, Rausch, Goldberg and Dodd (1968) found significant sex difference in the conceptual tempo of preschool children, it was deemed advisable to include sex as a control variable.

Data analyses employed the multiple linear regression model for hypothesis testing using the Stepwise Regression Program BMDO2R.[1] This approach generates a full model in the form of a regression equation, which includes all of the predictor information and a restricted model in the form of a regression equation, which leaves out some of the information of the full predictor set. The significance of the information excluded is obtained by testing the difference between the R^2 (square of the multiple correlation coefficient) of the two models with an F statistic (Bottenberg and Ward, 1963).

The test of significance for the interaction between conceptual tempo and treatments and the interaction between conceptual tempo, treatments and grade constituted the appropriate analysis addressed by the research questions of this study.

RESULTS

Interaction Effects

The means and standard deviations of the performance scores on the free recall task for the treatment by tempo by grade subgroups are presented in Table 2.

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[1] W. J. Dixon (Ed.), Stepwise regression program BMD02R. BMD Biomedical Computer Programs. Berkeley: University of California Press, 1970, Pp. 233-257.

The major hypothesis of this study states that there is a significant interaction between method of presentation and conceptual tempo. In order to test this hypothesis, it was first necessary to determine if any significant interactions existed at all. This was done by comparing the Full Model (1), which permitted all the interactions of interest to occur, with the Restricted Model (2), which did not permit these interactions to occur.

Presented in Table 3 are the summary data of the regression analysis for these two models and all subsequent models contrasted in the data analysis, with their corresponding F values.

The results indicated that there were no overall significant interactions present in the data ($F=0.40$, df 4/169). Although this lack of any overall interaction effect technically precluded a legitimate analysis of any of the interaction terms, an examination of the treatment by tempo interaction effect (see Figure 1) indicates that a slight interactional trend is present in the data. As indicated in Figure 1, the impulsive subjects showed larger differences in performance between the Part Method and the Standard Method than did the reflective subjects. This tendency toward interaction was in the direction that was anticipated. The performance on the Part Method and Rehearsal Method, however, was essentially constant across the two levels of conceptual tempo.

As can be seen in Table 2, optimal performance was obtained for both reflective and impulsive subjects in both grade levels under the Part Method. This method of presentation had a facilitating effect on the performance of both the reflective and impulsive subjects which was contrary to expectation.

For the reflective subjects, assignment to the Rehearsal Method produced

TABLE 2

Means and Standard Deviations of Criterion Score for

Treatment x Tempo x Grade Subgroups [a]

Group	Method					
	Part		Rehearsal		Standard	
	Mean	SD	Mean	SD	Mean	SD
Primary Reflective	56.20	4.06	51.20	5.13	53.07	4.74
Intermediate Reflective	57.13	3.24	54.13	4.19	56.13	3.68
Combined Reflective	56.70	4.22	52.67	4.84	54.30	5.14
Primary Impulsive	56.00	3.72	49.67	5.31	49.07	4.38
Intermediate Impulsive	57.20	4.46	55.80	3.19	55.53	5.38
Combined Impulsive	56.57	3.48	52.73	5.32	52.30	5.36

[a] N = 180

TABLE 3

Summary Results of Regression Analysis

Model	Predictors[a]	R^2	Source of Variance	% of Variance Explained	Degrees of Freedom	F
1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	.2961	All Predictors	.2961	13/166	5.4*
2	1, 2, 3, 4, 9, 10	.2566	Interaction Effects (Model 1-2)	.0395	7/165	1.2
7	2, 3, 4, 5, 6, 7, 8, 9, 10	.1842	Treatment Effect (Model 1-7)	.1119	2/165	13.3*
8	1, 3, 4, 5, 6, 7, 8, 9, 10	.2954	Tempo Effect (Model 1-8)	.0007	1/165	0.2
9	1, 2, 4, 5, 6, 7, 8, 9, 10	.1731	Grade Effect (Model 1-9)	.1230	1/165	29.3*
10	1, 2, 3, 5, 6, 7, 8, 9, 10	.2919	List Effect (Model 1-10)	.0042	1/165	1.0

[a]For clarity of presentation each predictor has been defined as a single vector. Predictors: 1=treatment; 2=tempo; 3=grade; 4=list; 5=treatment x tempo; 6=treatment x grade; 7=tempo x grade; 8=treatment x tempo x grade; 9=sex; 10=intelligence. In the actual equations employed in the regression analysis, two vectors were required to represent the three levels of the treatment variable and the related interaction terms.

*$P < .05$

the poorest performance while for the impulsive subjects, assignment to the Standard Method produced the poorest performance. In addition, there was no noticeable difference in performance between the reflective and impulsive subjects exposed to the Rehearsal Method of presentation.

Main Effects

The correlation coefficient matrix of the dependent variable considered in relation to the four independent variables of treatment, tempo, grade and list, in addition to the two covariates of sex and intelligence, is presented in Table 4. With respect to the dependent variable, treatment and grade produced significant correlation coefficients.

The means and standard deviations of the four independent variables are presented in Table 5.

Treatments. Table 3 presents the summary information for the Full Model (1), which took into account membership in treatment group, contrasted with the Restricted Model (7), which did not take treatment group membership into consideration. The difference between the R^2 of the two models yielded a significant F ratio of 13.3, df 2/165, $p < .05$.

The results of multiple comparisons of treatment means employing the Scheffé method indicated that performance was optimal with the Part Method when contrasted separately and jointly with the Rehearsal and Standard Method ($p < .05$). There were no significant differences between the Rehearsal and Standard Methods.

Tempo. Referring again to Table 3 we can see the summary results of the

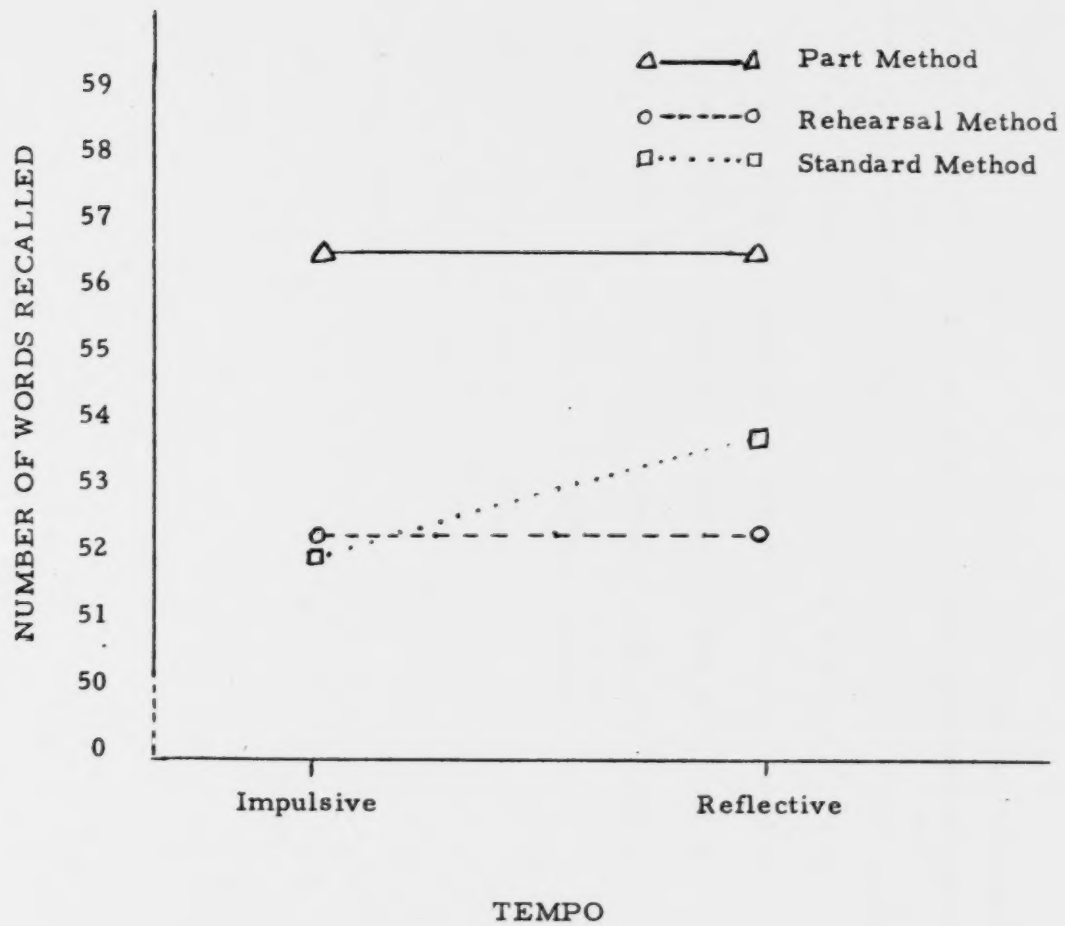

Fig. 1 Interaction trend between two levels of tempo and the three methods of presenting the free-recall learning task.

TABLE 4

Correlation Coefficient Matrix

Variable	1	2	3	4	5	6	7	8	9	10
1. Criterion	1.00	-0.320	0.320	0.059	-0.344	-0.061	0.126	-0.009	0.073	-0.118
2. Treatment		1.000	-1.000	-0.000	-0.000	0.014	0.103	-0.027	-0.015	0.010
3. Treatment			1.000	0.000	0.000	-0.014	-0.103	0.027	0.015	-0.010
4. Tempo				1.000	0.000	-0.000	0.142	-0.189	0.707	-0.792
5. Grade					1.000	-0.022	0.017	-0.145	-0.113	0.222
6. List						1.000	-0.019	0.056	0.040	0.008
7. IQ							1.000	-0.023	0.132	-0.227
8. Sex								1.000	-0.041	0.049
9. Response Time									1.000	-0.709
10. Errors										1.000

N= 180
p.05 =0.159
p.01 =0.208

TABLE 5

Means and Standard Deviations of Independent Variables

Variable	Levels	Mean	Standard Deviation
Treatment	Part	56.63	3.84
	Rehearsal	52.70	5.04
	Standard	53.45	5.28
Tempo	Impulsive	53.97	5.09
	Reflective	54.56	4.98
Grade	Primary	52.53	5.29
	Intermediate	55.99	4.11
List	A	53.96	5.00
	B	54.57	5.08

Full Model (1), which took into account membership in the treatment group and the Restricted Model (8), which did not take this information into account. A comparison of the R^2 of the two models yielded a nonsignificant F value of 0.17, df 1/169. The data also indicated that conceptual tempo accounted for less than 1% of the criterion variance.

Grade. Also presented in Table 3 are the summary results of the Full Model (1), which took into account grade membership and the Restricted Model (9), which did not take this membership information into account. When the R^2 of the two models were compared, a significant F value of 28.91 was obtained, df 1/169, $p < .05$. The data indicated that the intermediate grade subjects ($\bar{X}$=55.99) recalled more words than did the primary grade subjects ($\bar{X}$=52.53).

List. Referring to Table 3 we can see the summary results of the Full Model (1), which took into account list membership and the Restricted Model (10), which did not take this information into account. A comparison of the R^2 of the two models yielded a nonsignificant F value of 0.79, df 1/169.

Results of the Matching Familiar Figures Test

A zero-order correlation coefficient matrix indicated a significant negative relationship between response time and errors (-.709) on the MFF. A low but significant relationship (.222) between grade and errors was observed with a corresponding negative nonsignificant relationship (-.113) between grade and response time.

With respect to intelligence, the results indicated a nonsignificant relation (.132) between IQ and response time with a low but significant negative relationship (-.227) existing between IQ and errors.

DISCUSSION

In regard to the major hypothesis of this study, which stated that there was a significant interaction between methods of presenting the free recall learning task and the conceptual tempo of the learner, the data indicated that this hypothesis was not confirmed. Furthermore, the exploratory hypothesis, which postulated a joint effect of method of presentation, conceptual tempo, and grade, was not substantiated by the results.

A number of possible interpretations can be offered in order to account for these unexpected findings. The explanations will focus on the instructional treatments and aptitude variable considered in this study.

In regard to the instructional options employed in this study, the results indicated that performance under the Part Method was significantly different from that under the Standard and Rehearsal Methods, but the Part Method did not elicit differential effects for reflective and impulsive subjects. Overall, the data indicated that optimal performance was obtained for both the reflective and impulsive subjects on both grade levels under the Part Method.

With the Part Method, the free recall task was divided into two components, which were practiced separately and then combined to form the whole list. The superiority of the Part Method may be attributed to the fact that this method

adjusted the material to the memory span of the subjects and provided an optimal amount of time as well as a strategy for organizing the informational input. Some support for this view can be found in the studies undertaken by Ryan (1969a, 1969b) who indicates that the grouping of a sequence of items on a short-term visual memory task facilitates recall. Ryan attributed the superiority of grouping of items to the subjects using the intervals between groups to practice previous items without having to attend to new incoming items. With the Part Method, where the materials were subdivided into small and relatively easy units, the advantage may be said to be a function of the additional intervals between units which provided extra time for the practice of the subsets of items, without interference from new incoming items. It would appear that the organizational strategy inherent in the Part Method, whereby the material is subdivided into small units, does facilitate recall performance.

In regards to the expected interaction effect, it was anticipated that the Part Method, by grouping the items into subsets during presentations, would facilitate the performance of impulsive subjects by compensating for their apparent information processing deficiencies as well as meeting their apparent need for quick success. On the other hand, it was anticipated that since the Part Method grouped the items for the subjects it would have a debilitating effect upon the reflective subject because it would interfere with the groupings of his own making. That is, the organization of items imposed in the Part Method would require the reflective subject to adopt an order for recall different from or incompatible with the one he would normally choose were he free to recall without this constraint.

While the results clearly indicated that the Part Method had a facilitating effect on the performance of impulsive subject, they also indicated that contrary to expectation, the Part Method also had a facilitating effect on the reflective subject. This result can perhaps be accounted for by the degree of congruence between the organization of the part list and the organization of the whole list. Cunningham (1971) maintains that negative transfer occurs when the part and whole organization are incompatible, while positive transfer occurs when the part organization is congruent with the whole organization. Since the items used in this study were essentially unrelated to one another, being constructed so that there was no inherent organization from a conceptual, perceptual, or associative aspect, it would appear that positive transfer occurred between the part organization and whole organization for both reflective and impulsive subjects. Apparently, since the list of items did not possess an inherent structure or organization, the experimentally produced subgroupings were adopted by the reflective subject, who it was anticipated would have generated groupings of his own making. If the items used in this study had been related in some way, for example conceptually, and the subdivision did interfere with the whole organization, thereby producing negative transfer, it is possible that the anticipated results might have occurred.

The Rehearsal Method, on the other hand, produced the poorest performance for both the reflective and impulsive subjects with the one exception being the impulsive subjects assigned to the Standard Method. The results indicated that there was no noticeable difference in performance between the

reflective and impulsive subjects exposed to the Rehearsal Method of presentation. This failure to find facilitation under the Rehearsal Method for the impulsive subject was unexpected.

It had been expected that the Rehearsal Method would enforce the attention of the impulsive subject on the information being presented as well as provide him with cues for memory supports by making him overtly repeat the name of each stimulus as it was presented. On the other hand, the Rehearsal Method was expected to hinder the performance of the reflective subject by interfering with his own strategy for rehearsal. The data supports this anticipated debilitating effect with the Rehearsal Method for reflective subjects but provides contrary evidence for a facilitating effect for impulsive subjects.

The results indicated that requiring the production of an overt verbal response does not facilitate learning in a free recall task. These results are inconsistent with previous research which indicates that verbalization positively affects the recall and learning of young children.

One possible explanation for the lack of a facilitating effect for the impulsive subject exposed to the Rehearsal Method used in this study can be found in the investigation conducted by Bernbach (1967). The results of his investigation indicated that verbalizing promotes rehearsal, especially when the stimuli are difficult to label and would not normally be spontaneously labeled. Since the items used in this study were all pictures of highly familiar objects, it is possible that the self-cueing effect of overt labeling was of minimal importance to the impulsive subject. Had the items used in this study been difficult to label, it is possible that the overt labeling would have facilitated the performance of

the impulsive subject and produced the desired interaction effect.

Of the three methods of presenting the free recall task, only the Standard Method produced a noticeable difference between the reflective and impulsive subjects. This difference, while in the predicted direction, was not of sufficient magnitude to produce the desired interaction effect. This interaction effect was predicated on the supposition that the Standard Method favors the reflective subject, because it provides him with a great deal of associational latitude and freedom of constraints in organizing the materials, while it was anticipated that the Standard Method would handicap the impulsive subject, because it does not provide him with a systematic method of coping with the materials.

Overall, the absence of an ATI can no doubt be attributed to the lack of sufficient uniqueness in the three treatments to elicit the differential effects for reflective and impulsive subjects. While it is possible that the present study did not provide the appropriate instructional options relative to the conceptual tempo dimension of the subjects, it is also just as plausible to entertain the notion that the nature of the free recall task is one that inhibits or precludes the production of an interaction effect.

The free recall task is a simple rote memory task, which suffers from the inherent characteristics of brevity and artificiality. Since a list of only 8 items was required to be recalled in this study, it may be that because of the brevity of the task, the conceptual tempo dimension of the subjects did not have a sufficient opportunity to come into play. The artificiality and lack of complexity of the free recall task may not have elicited the subjects conceptual tempo

simply because of the relative ease with which this type of task is performed. In addition, the free recall task, when compared to other problem-solving tasks, does not contain a high degree of response uncertainty. It is interesting to note that the task employed in this study was unrelated to intelligence as opposed to more complex tasks in other studies where outcomes typically related positively to mental ability.

It may be that because of the simple nature of the task, subjects were not sufficiently motivated as they might have been had a more challenging task been employed. It is, therefore, possible that the desired interaction effect would have occurred in this study if a task of a longer duration or of a more complex nature, which contained more response uncertainty, had been employed.

With respect to the aptitude of conceptual tempo, it is believed that the MFF measure was sufficiently valid in classifying the subjects as being reflective or impulsive. The conceptual tempo characteristic of the learner, however, was found not to be a factor in determining which of the three methods of presenting the free recall task was most efficient. In fact, the results indicated that conceptual tempo accounted for less than 1% of the criterion variance.

Since conceptual tempo accounted for only an insignificant portion of the explained variance, a question has to be raised about its utility for prescribing methods of presenting verbal learning tasks. Failure to attain the ATI effect may have occurred because variations along the conceptual tempo dimension are essentially unimportant in these types of tasks. It may be that other cognitive style dispositions, such as the difference between verbalizers and visualizers that Mallory (1972) has recently studied would be more appropriate

for matching students with methods of presenting verbal learning tasks. The possibility also exists that task performance is dependent upon multiple cognitive style aspects of the individual working simultaneously.

Overall, the results indicated that the difference between methods produced no clearly significant ATI effects, and that conceptual tempo appears to have little value as a classificatory variable for assigning subjects to different methods of presenting the free recall task used in this study.

Despite the absence of any interaction effect in this study, the author is in agreement with the sentiment expressed by other investigators (Cronbach & Snow, 1969; Ripple, Millman, & Glock, 1969), that it would be a mistake to rule out the notion of ATI in any formula designed to explain the learning process. For to abandon the ATI model is to essentially acknowledge that when you present the same objectives to students there is but one best method of instruction for everyone, and consequently, the instructional methods do not have to be differentiated to match the individual characteristics of learners. Assuming that aptitude treatment interactions exist (even though they were not detected in this study) it would appear that greater efforts will have to be directed at discovering those methods of instruction which are sufficiently unique so as to elicit differential effects for different type students.

With respect to the MFF test performance, there was a highly significant negative relationship observed between errors and response latency, with a low but significant negative relationship between errors and intelligence, and a non-significant positive relationship between intelligence and response latency. These results are consistent with numerous findings by Kagan and his associates

that response time is orthogonal to intelligence, with error scores usually maintaining a low negative relationship with intelligence. On the other hand, these results are contrary to the recent findings of Eska and Black (1971) who reported a significant relationship between response latency and intelligence as well as error scores and intelligence.

These disparate results can perhaps be accounted for by the type of IQ measure administered to the subjects in the various studies. The significant correlations between intelligence and response latency that Eska and Black obtained were based on IQ measures designed to assess nonverbal abilities. In the present study, the IQ measures were those that emphasized verbal intelligence as was true of the Kagan studies. It would appear that response latency is correlated with IQ measures that assess nonverbal abilities but not with IQ measures which emphasize verbal abilities.

This relative independence of conceptual tempo from the usual indices of ability is of educational significance, since it indicates that the traditional measures of intelligence obtained on children do not indicate the full cognitive variation present in the repertoire of all children. The implication of this finding is that educators should modify their assessment procedures when identifying young children by including cognitive style measures in the test batteries that they employ.

Further research efforts should be directed at the development of other valid and reliable measures of cognitive style which are relevant to the occurrence of ATI. So long as educators continue to confine their assessment procedures to the traditional measures of ability, effective teaching methods

which attempt to deal with individual differences will be handicapped in their development, for the basic notion of the ATI model is predicated upon the ability to identify and measure those variables which are related to educational outcomes that define similar learners. Without a concerted effort within the educational community in the development of these measures, the goal of individualizing instruction based upon a match between the characteristics of the learner and method of instruction will merely remain a hollow educational dream.

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